

Classification, Interdisciplinarity, and the Study of Science

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Abstract: Classification, Interdisciplinarity, and the Study of Science

Purpose – This paper responds to the 2005 paper by Hjørland and Nissen Pedersen by suggesting that an exhaustive and universal classification of the phenomena that scholars study, and the methods and theories they apply, is feasible. It is argued that such a classification is critical for interdisciplinary scholarship.

Design/Methodology/Approach – Literature-based conceptual analysis, taking Hjørland and Nissen Pedersen (2005) as its starting point. Hjørland and Nissen Pedersen had identified several difficulties that would be encountered in developing such a classification; the paper suggests how each of these can be overcome. It also urges a deductive approach as complementary to the inductive approach recommended by Hjørland and Nissen Pedersen.

Findings – An exhaustive and universal classification of scholarly documents in terms of (at least) the phenomena that scholars study, and the theories and methods they apply, appears to be both possible and desirable.

Practical Implications – The paper suggests how such a project can be begun. In particular it stresses the importance of classifying documents in terms of causal links between phenomena.

Originality/Value – The paper links the information science, interdisciplinary, and study of science literatures, and suggests that the types of classification outlined above would be of great value to scientists/scholars, and that they are possible.

Keywords – Classification, Information Retrieval, Interdisciplinarity, Phenomena, Theory, Method

Paper Type – Conceptual paper

Hjørland and Nissen Pedersen (2005) end their recent paper in this Journal with a claim that ‘a theory of classification is especially connected to science studies’ (594). They do not make a similar claim regarding ‘interdisciplinary studies,’ but rather propose an approach to classifying scholarly documents that they appreciate must produce different systems of classification for different fields of inquiry. This brief paper draws on recent literature at the intersection of the study of interdisciplinarity and the study of science to suggest an alternative vision to theirs of the possibilities of classifying at least scientific (scholarly) documents.[¹]

While the interest of the academy in interdisciplinarity has ebbed and flowed over the last century, there is good reason to believe that interdisciplinarity will be increasingly important in the future. Pressing social and environmental problems call for interdisciplinary analysis. Students and employers recognize that life’s challenges do not come in neat disciplinary bundles but require the ability to draw connections across different areas of expertise. ‘As research and knowledge become more interdisciplinary, the academic subjects represented in our research libraries become increasingly ill-suited to the conduct of research’: a more interdisciplinary scientific enterprise requires radical change in classificatory practice. (Palmer, 1996, 66). J.D. Brown, Kyle, Douglas Foskett, Austin, Beghtol, and Williamson are among the information scientists who have over the years noted that ‘disciplines are an arbitrary constraint on classification schemes, and produce obstacles to cross-disciplinary indexing and searching’ (Gnoli, 2006, 11). Dahlberg (1994) identifies five types of interdisciplinary research, each of which is poorly served by existing classifications. When one discipline is informed by many others, or one topic studied by many, related documents are inevitably classified in a

dispersed fashion. Bulick (1982) has noted that some subjects thus receive multiple classifications, interdisciplinary subjects receive arbitrary classifications, and confusion occurs when disciplinary boundaries shift. Interdisciplinary scholars want information scientists to translate jargon across disciplinary boundaries (Palmer, 2001, 131). The strategy advocated by Hjørland and Nissen Pedersen can do this only to a limited extent; as we shall see a complementary deductive strategy is necessary to fully facilitate interdisciplinary research.[²]

The Purpose of Classifications of Scholarly Documents

Hjørland and Nissen Pedersen draw an important distinction between a ‘positivist’ and a ‘pragmatic’ approach to classification. The former views classification as an ‘abstract or empirical process’ while the latter involves ‘classification in response to an objective’ (584). Stated in this form, I, like Spärck Jones (2005) to whom their paper is a response, respect their preference for a pragmatic approach:[³] Classifications can only be judged in terms of the objectives of those who utilize them, and are thus best constructed with careful attention to those objectives. Indeed, the main contention of this paper is that as scholarly research becomes increasingly interdisciplinary, a – perhaps ‘the’ – key purpose of systems of classification is to facilitate interdisciplinary research and information sharing. Since Hjørland and Nissen Pedersen recognize that their approach cannot achieve this objective, this paper seeks to identify the adjustments that must necessarily be made to their argument and approach in order to facilitate interdisciplinary analysis. More precisely, this paper seeks to show that the critical objective of facilitating interdisciplinary scholarship can be salvaged while maintaining the key premises of the argument of Hjørland and Nissen Pedersen.

Hjørland and Nissen Pedersen recognize (594) that the task of classification is rendered much more difficult if the purposes of the users of the classification are imprecise. Indeed, ‘a consideration of that purpose is the most important part of the methodology of information science’ (584). They worry that ‘users are normally not able to specify criteria in a literature of which they are not knowledgeable’ (591). Yet it is nevertheless possible, at the most general level, to identify clear purposes pursued by scholars in general and interdisciplinary scholars in particular, in searching the scholarly literature – purposes that are poorly served by existing systems of document classification. The vast bulk of scholarship involves the application of one or more scholarly theories and scholarly methods to the study of one or more phenomena (see Szostak 2004). Scholars performing such research are naturally curious as to whether the theory and/or method they wish to apply to the study of their particular set of phenomena has been applied before. They thus wish to be able to search primarily by theory applied, method applied, and phenomena studied. Yet documents are generally classified exclusively by subject matter, by what a work is ‘about’: theories and methods are classified only when a work is about theory or method, not when these are applied (Weinberg, 1988).^[4] Even with respect to phenomena, documents are not classified according to some universal schema but according to the different terminology employed by diverse disciplines. As Hjørland and Nissen Pedersen (586) note, the words used in different disciplines are never perfect synonyms. Thus even thesauri cannot flawlessly guide the scholar to relevant works in other disciplines. As Weinberg (1988) recognized, in the absence of reliable interdisciplinary classifications, scholars are forced to rely on a handful of time-consuming and flawed procedures, such as asking colleagues for advice,

consulting specialized bibliographies, or identifying key works in other disciplines and tracing their citations. Notably, these practices often require the researcher to first identify relevant disciplines. However, the most useful information is the most surprising, and this will often be information the researcher would not have searched for (Palmer, 2001). And of course scholars often ‘reinvent the wheel’ through ignorance of previous work.

I do not mean to suggest that classification by theory, method, and phenomena are the *only* sorts of classification needed by scholars, just that these are by far the most important objectives currently ill-served by classificatory practice. For some documents classification in terms of the types of data investigated might be very useful. Some documents are critiques of the practices of other scholars, and can usefully be classified in terms of type of critique. And of course classification with respect to time and place and type of document is still very useful (though these tasks are generally well served by existing systems of classification). (Szostak 2004, ch.7)

Beghtol (1995) explores the idea of ‘undiscovered public knowledge’: insights that have been published but are undiscovered because their relationship to other fragments of understanding is not appreciated. Drawing on previous research by others, she noted five resulting problems: evidence that might refute a hypothesis is not recognized, evidence that might add additional support to a hypothesis is likewise not appreciated, analyses of missing links in a causal chain are ignored, solutions to analogous problems are missed, and unimagined correlations between concepts are not recognized. The strategies generally recommended for uncovering ‘undiscovered public knowledge’ rely heavily on serendipity. Moreover they tend to be discipline-specific,

whereas the likelihood of undiscovered public knowledge increases with interdisciplinary interaction (Beghtol, 1995, 195-6). Notably, each of the five problems enumerated by Beghtol could be remediated if it were possible to search by (links between) phenomena, theories, and methods.

Scholars of interdisciplinarity have independently reached the same conclusion as Weinberg regarding the particular importance of classification by theory, method, and phenomena. Both Klein (1990) and Salter and Hearn (1996) identify these as key identifying characteristics of disciplines, and thus the key elements that interdisciplinary scholarship must integrate across. To be sure, they speak of two other disciplinary characteristics: disciplinary perspective (or worldview), and disciplinary rules. The former involves the general approach (including ideological, epistemological, and ethical elements) of members of particular disciplines, and the latter involves the standards of peer evaluation that characterize a discipline. Notably, in practice both of these primarily serve the interdisciplinarian in evaluating how the insights produced by a discipline's theories and methods may have been shaped by its worldview and incentive structure (see Repko 2006 for a discussion of interdisciplinary practice). For present purposes, it is most useful to note that these characteristics operate at the level of disciplines rather than individual works, and are thus best mastered by reading general works about disciplines or interdisciplinarity. They do not, then, present difficult challenges to information science.[⁵]

Hjørland and Nissen Pedersen (586) follow Rey (1998, 505) in arguing that '... there is considerable disagreement about what exactly a concept is' but that concepts '... seem essential to categorizing the world.' If concepts are essential but indefinable, then

information scientists must necessarily struggle to classify scholarly documents for any purpose. At least with respect to scientific documents, though, it would seem that concepts should refer to specific phenomena or sets of phenomena, or theories or methods or components thereof (Wallace and Wolf, 2006, 4-5; Repko 2006). That is, scholarship involves the application of theories and methods to the study of sets of phenomena (and the interactions among these), and thus scholarly concepts should refer to one of these. If concepts are clearly defined with respect to phenomena, theories, or methods, and documents are classified in terms of phenomena, theory, and method, then all concepts will be captured by the classification. As both Hjørland and Nissen Pedersen and Rey would expect, an understanding of what a concept is leads to an understanding of how to classify.

Reflections on Spärck Jones

Hjørland and Nissen Pedersen were responding to Spärck Jones (2005). Spärck Jones worried that classificationists could easily lose sight of the principles of classification while engaging in inductive work (571). This paper, like that of Hjørland and Nissen Pedersen, urges classificationists to reflect on the precise needs of users, but also urges the complementary pursuit of inductive and deductive analysis. Spärck Jones also worried that the activity of classification inevitably involves the loss of information, for the differences among objects in the same class are ignored (571). Hjørland and Nissen Pedersen hope to minimize information loss by inducing scholarly consensus on terminology (but thus necessarily only poorly capturing works operating outside this

consensus). This paper argues that this sort of information loss will be minimized for scholarly works if each work is classified in terms of all phenomena or causal links studied plus the theories and methods utilized, for these characteristics are the essence of scholarly work, and generally lend themselves to precise definitions.

Spärck Jones developed a three-dimensional typology of classifications. Classes could be either ordered or non-ordered, exclusive or overlapping, and monothetic (objects share one property) or polythetic (objects share some of a set of properties). Spärck Jones argued that the choices made in these three respects when classifying should reflect both classification theory and the objectives of a particular classification; in general one would evaluate the latter in terms of the former. Exclusive reliance on Hjørland and Nissen Pedersen's inductive approach of looking for co-occurrence of terms would produce a non-ordered, overlapping, and polythetic classification. Such classifications are necessarily grounded in the discourse of one academic community and will be difficult to decipher by scholars from outside that community.

This paper will argue instead that the objective of serving interdisciplinary scholarship is best realized by a classification that is primarily:

- Ordered. It will be suggested that phenomena and methods be sorted and organized hierarchically. Theories are classified in terms of a handful of key characteristics.
- Exclusive. Phenomena, theories, and methods can generally be defined precisely enough to ensure exclusivity. In practice, some limited overlap may occur, but neither Spärck Jones nor Hjørland and Nissen Pedersen would object to a universal classification on these grounds.

- Monothetic. Phenomena are defined either in terms of their essence or function.

While the approach to classification to be recommended in this paper is thus quite different from that in Hjørland and Nissen Pedersen, it flows not from the rejection of their inductive approach but from harnessing this to a compatible deductive approach.

Using Deduction and Induction to Develop a Universal Classification

Given their concern regarding the feasibility of defining the essence of concepts, Hjørland and Nissen Pedersen are naturally skeptical of the possibility of deriving a classification deductively from first principles. They advocate the autonomous development of classifications: only by looking at documents produced by a particular community of scholars and seeking commonalities (without any attempt to deduce classes) can one develop classifications that adequately serve that class of documents. Such a strategy has many merits but it also presents difficulties. One potential problem is that the sorts of shared understandings that Hjørland and Nissen Pedersen hope to discover inductively evolve (sometimes rapidly) through time, and thus their classifications will soon fail to provide appropriate guidance. Indeed the very boundaries and characteristics of the academic communities or disciplines that would be the focus of their efforts change through time (see Klein, 1990 or Salter and Hearn, 1996). The fact that disciplines, unlike the phenomena they study, can only be induced at a point in time rather than deduced, renders these a problematic base on which to build a classification.

For the purposes of this paper a more serious problem is that it is difficult to extend inductively derived classifications over ever-wider sets of documents. Hjørland

and Nissen Pedersen ask themselves ‘why prefer such an approach when we do not believe that it is generalizable to other homographs or other literatures?’; their answer is that they thus hope to learn about [induce] the standardized practices of particular literatures. However, if it is true that interdisciplinarity characterizes the future of scholarship, the primary goal of information science with respect to the classification of scientific documents should be a universal classification that allows scholars located anywhere in the academy to readily find relevant documents authored by scholars located elsewhere in the academy. Moreover it will be argued that the ‘standardized practices’ of the scholarly enterprise as a whole can be identified well enough for such a project to be feasible. Notably, such a classification will at the same time achieve a key goal of information science: a classification system that potentially provides a unique place for each document; this goal is unattainable within classification systems grounded in disciplines (Bulick, 1982, Gnoli and Poli, 2004).

Philosophers of science (at least those who believe that scientific understanding can advance) recognize that scientific understanding advances best when both induction and deduction are employed. A purely deductive enterprise can easily become untethered from reality, while a purely inductive enterprise can too easily miss the connections among diverse observations (Gower, 1997, 254). Information science too can benefit from a mix of induction and deduction. Rowley (1992, 159-60) has indeed argued that information science has generally been inductive in orientation – classificationists surveyed the works to be classified and went from there – and applauds efforts to deductively ground classifications in a theoretical understanding of the structure of

knowledge. The strategy recommended by Hjørland and Nissen Pedersen is inductive; is there a deductive strategy that might complement it?

The answer to this question follows from the discussion of concepts above. Scholarly works should be classified in terms of the phenomena studied and theory and method used. The possibility of exhaustive and universal classifications of phenomena, theories, and methods should not be arbitrarily dismissed. As Rowley noted above, information scientists can usefully turn to the scholarly literature itself for efforts to deductively establish such classifications. The feasibility of such classifications can then be tested and improved upon by the use of the inductive methodology advocated by Hjørland and Nissen Pedersen. Most obviously, induction could establish if some phenomena, theories, or methods are missing. Induction could also usefully establish whether some elements in the classification often/always co-occur with others.

At least at the highest level of generality such classifications have been developed (Szostak, 2003a, 2004). Phenomena can be arranged in terms of level of complexity.^[6] Theories can be classified in terms of key characteristics such as type of agent posited, type of behavior explained, and type of decision-making process (if any). By placing individual theories within such a typology, the problem identified by Hjørland and Nissen Pedersen of quite different types of theory utilizing the same theory title can be readily accommodated. Different instances of the use of the theory name can be placed within different theory types: researchers can if they wish search across all uses of the theory name, but can also search only for certain types of that theory. Interdisciplinary scholars will often wish to search just by theory type itself, and can then identify similar theories operating under different names in different scholarly communities. Methods are even

easier to grapple with, for scholars use only a dozen methods, broadly defined: classification itself, experiments, interviews, surveys, observation, statistical analysis, mathematical modeling, textual analysis, mapmaking, hermeneutics/semiotics (the study of symbols), the study of physical traces (as in archaeology), and experience/intuition (see Szostak 2004, 101-2). These can be unpacked into a larger number of specific techniques. To be sure these classifications would need to be fleshed out in more detail for use in document classification. As noted above the inductive techniques advocated by Hjørland and Nissen Pedersen can be utilized to advantage in such an endeavor.[⁷]

Hjørland and Nissen Pedersen (585-6) correctly note that much recent scholarship in the study of science – drawing in turn on postmodern insights from a variety of fields – suggests caution here. Human understanding of any ‘object’ is not absolute, but is mediated by imperfect human perceptions: individuals can thus disagree in important respects about what the object is. Moreover language itself is inherently ambiguous, and thus different users will interpret differently each word that is used in a classification (as in any text). These critiques are important, but one must be careful of conflating ‘imperfect’ with ‘impossible.’ Not just scholarship and classification but indeed everyday life would be impossible if we could not achieve some degree of consensus on what is the essence of particular objects or words. Hjørland and Nissen Pedersen worry (585) in particular that ‘if observations are theory-dependent, only very trivial observations may be shared among all observers, and consequently we have to base our classifications on trivial descriptions rather than on important or essential descriptions.’ Yet surely this is an empirical question: to what extent can theory-independent but substantive classifications be developed? The research strategy Hjørland and Nissen Pedersen

advocate is predicated on the belief that this is possible, if only over constrained subsets of the scholarly literature. More generally the question becomes one of whether enough (imperfect) consensus can be achieved to support an exhaustive classification of phenomena, theory, and method: note again that a deductively generated classification could be enhanced and verified through the use of Hjørland and Nissen Pedersen's inductive methodology.[⁸]

Examples of Classification of Phenomena and Causal Links

A complete answer to this empirical question – to what extent can universal theory-independent but substantive classifications be developed? – cannot of necessity be provided in any one brief paper. However, Hjørland and Nissen Pedersen, in providing several examples of difficulties with such a classificatory endeavor, set the stage for a powerful test of the possibility of such a classification. If it can be shown that each of these examples – provided by these authors in order to establish the difficulty or even impossibility of universal classification – can in fact be dealt with, then we have good reason to expect that such a classification is indeed possible. Hjørland and Nissen Pedersen note (585) that pharmacology and chemistry emphasize different properties of the same chemical compound. This need be no barrier to a useful universal classification. Compounds can be classified in terms of their constitutive chemical elements. The objective of chemists – the study of how different elements or compounds combine – can be served in a classification by identifying 'causal links' among different elements or compounds.[⁹] Likewise, physiological effects could be captured by links between particular chemical compounds and some classification of physiological reactions. Both

chemists and pharmacologists could easily find what they needed, as could those, like biochemists, who may wish to pursue both types of links.

Later (588) Hjørland and Nissen Pedersen discuss the possibility that a particular substance may be viewed as food in one society but not another. Here again it is possible to define food fairly precisely in terms of whether a substance affects the human body physiologically when ingested. Links between this category of phenomena called ‘food’ and cultural attitudes could then capture why a particular society disdains a substance with nutritive qualities, or applauds a substance with none. Note moreover that any food can be identified in terms of whether particular phenomena within the broader category of substances are thought to have positive causal linkages with elements of human physiology.

The role of causal links deserves emphasis: much of the ambiguity that troubles Hjørland and Nissen Pedersen can be handled by defining phenomena narrowly *but allowing scope for classification by causal links between phenomena*. Such a strategy reflects a key insight of facet analysis: the value of notationally linking subjects.^[10] Rowley (1992, 240) and Marcella and Newton (1994, 60) are among many information scientists who have urged the use of linked notation. A focus on causal relations is at least as important from the study of science perspective. While some scholars concern themselves with the definition or internal dynamics of a single phenomenon, the vast bulk of scholarly research discusses the influence that one or more phenomena exert on one or more others. Classification in terms of causal links allow researchers to zero in on the literature they want, while classification in terms of phenomena alone forces them to recover works that deal with quite different causal relationships.^[11] As noted above, the

linked notation allows chemists to find what they want, and pharmacologists to find what they want, whereas if the literature were coded in terms of only the main chemical compound investigated they would both recover much that was of no interest.[¹²]

Hjørland and Nissen Pedersen follow their discussion of food by suggesting that the links between concepts depend on theories. Indeed, one theory may posit a link between phenomenon A and phenomenon B that alternative theories dispute. Scholars may disagree over whether a particular compound has a particular effect (591). Both sorts of study deserve to be classified as studying the same causal link. As noted at the outset, scholars wish to search for previous cases in which a particular causal link has been studied, and should be interested in both positive and negative findings.[¹³] Scholars will benefit from a universal classification that encompasses all possible links, but will flounder in a system of local theory-dependent classifications if different scholarly communities have achieved different understandings of the same causal link.[¹⁴] In other words, such scholarly disagreement need not, as Hjørland and Nissen Pedersen suggest, complicate the task of classifying documents, but rather provides a further rationale for a universal classification.

This particular example also highlights the value of classifying by theory applied (and by implication by method applied as well). Indeed, Hjørland and Nissen Pedersen themselves recognize the value of distinguishing works in terms of theory applied in this context. While ideally scholars should have some interest in what alternative theories (or methods) imply about their phenomena of interest, they may nevertheless be primarily interested in looking only at previous applications of one theory (and one method) to a particular set of phenomena – or may indeed wish to investigate applications of that

theory or method to other (perhaps related) phenomena. The classification of documents with respect to theory and method applied as well as to phenomena studied allows this objective to be served.

Ambiguity of Language

Few would doubt that we can develop an exhaustive and universal classification of chemical elements.^[15] Yet as Hjørland and Nissen Pedersen note Thomas Kuhn followed Wittgenstein ‘in rejecting a specific set of properties as the basis for class membership, [and] thus rejects the traditional view that concepts and classes can be defined in terms of necessary and sufficient properties’ (587). Chemical elements are hardly alone among natural science phenomena in providing fairly objective standards for classification. When what a phenomenon ‘is’ is less obvious, as often is the case with human science phenomena especially, phenomena can usually be defined fairly objectively in terms of what they ‘do’: an ‘institution’ is a set of formal rules with formal sanctions attached, a personality dimension affects how individuals behave, and a cultural attitude toward punctuality affects the likelihood that an individual will arrive on time. Notably, Hjørland and Nissen Pedersen (589) draw on Kirkehei (2004) who identified three broad senses in which the phrase ‘activity theory’ was used: Kirkehei draws functional distinctions, as the phrase is used in different disciplines to study different processes. A strategy of identifying human phenomena functionally, but atoms in terms of their essence, reflects the insight of Gnoli and Poli (2004, 155): they identify various levels of complexity in subject matter, and argue that function only matters for levels of complexity at or above the biological.

Hjørland and Nissen Pedersen note that Wittgenstein's 'family reference account allows for taxonomies being dynamic entities, which *may* undergo change' (586; emphasis mine). In the case of some human science phenomena, such as personality dimensions, it is indeed true that the scholarly understanding of the essence of phenomena will change through time. In other cases, this is much less likely: financial institutions have increased in complexity in recent decades and new financial institutions have emerged, but we can nevertheless define 'financial institutions' precisely in terms of a specific set of functions (providing an intermediary between savers and investors, facilitating transactions, and so on). Systems of document classification may still need to evolve as new realizations of a phenomenon occur. But note that the basic structure of the classification system may change little over time: within the unchanging class of financial institutions we need only to be willing to develop new subclasses if novel institutions emerge.

Scholars of interdisciplinarity appreciate that disciplines choose a mutually supportive set of theory, method, and phenomena. Disciplines investigate only those phenomena that lend themselves to the application of favored theory and method, and define phenomena accordingly. Information scientists need not and should not celebrate disciplinary idiosyncrasy. Hjørland and Nissen Pedersen follow Anderson (2002) in preferring to define concepts theoretically rather than pursuing the 'classical' approach to concepts that sought a 'set of individually necessary and jointly sufficient properties.' They note that classifications of sub-atomic particles depend on theories. Even here, it is likely true that one could develop a classification of 'types of particles' that could subsume the predictions of different theories. Alternatively, such phenomena could be

treated as subsets of relevant theories and classified only under works about theory until scholarly consensus on appropriate classification of phenomena is achieved. But the point to emphasize here is that sub-atomic particles are an outlier in terms of how difficult it is to define their essence in the absence of theory. As seen above, it is possible to define some – and likely the vast bulk of – phenomena in terms of either their essence or their function.[¹⁶]

Moreover, the theoretical differences that Hjørland and Nissen Pedersen stress will generally affect the causal links that are emphasized by a community of scholars much more than their definitions of phenomena. Thus, differences in definition of phenomena may be more apparent than real. For example, it is often noted that natural scientists define gender physiologically while humanists define it culturally. Yet we can still recognize some key physical differences (on average) at the core of gender and then study/classify the links between these and cultural attitudes. Classificationists need not and should not take a stand on to what extent gender roles are culturally determined, but rather provide a classification system where there is an obvious place for all types of argument.

In sum, it is possible to accept various ‘constructivist’ critiques of the accuracy of human perceptions of reality while still embracing a ‘realist’ perspective that the world is made up of real phenomena that we perceive imperfectly. It is an empirical question as to whether scholars can achieve consensus on the nature of particular phenomena. Hjørland and Nissen Pedersen *assume* that consensus is possible, but only within particular communities. Yet for every example they provide of difficulties in achieving cross-community consensus, strategies to overcome these difficulties appear to be

available. Given the increasing importance of interdisciplinary scholarship, these strategies should be pursued.

Minority Discourse

Hjørland and Nissen Pedersen (593) worry that their preferred approach may disadvantage minority discourse: a classification system grounded in a particular literature may obscure the works of those with differing views. A congeries of classifications grounded in distinct discourses may provide some solace: small communities of scholars can at least classify their own works, but will be invisible to others. Yet Hjørland and Nissen Pedersen themselves recognize (a key insight of the scholarship of interdisciplinary) that ‘it is important that users of a classification have access to different views.’ This can be accomplished to only a very limited extent if we take as our starting point a belief that classification is only possible over communities of scholars that share a host of understandings. On the other hand, an exhaustive universal classification can provide an obvious place for all points of view. If works are classified by phenomena studied, researchers could readily access all relevant literature. Those interested in only the application of a particular theory and/or method may, alternatively, wish to limit their search to applications of these.

Classifying by Theory and Method

Much of the foregoing analysis has discussed the advantages of classifying documents with respect to a classification of phenomena (and the links among these). Interdisciplinary in particular, but also more specialized scholars, also need to be able to search by method and theory. Indeed, scholarship advances through the careful identification of the range of applicability of theories and methods, and this can only

happen if researchers are aware of other applications of a particular theory or method. In the case of method, there are only about a dozen methods used by scholars, and a manageable number of distinct tools and techniques within each. If authors/publishers would be explicit about method(s) applied in a work, it would be straightforward to classify all works in terms of method applied. Theory presents a greater challenge, but it is possible to attempt a typology of 'types of theory' (Szostak 2004). Such a classification would allow researchers to identify similar theoretical endeavors across disciplines even when these go by a different name. It would also overcome the problem investigated by Kirkehei of quite different theories operating under the same name.

How should disagreements between mainstream and alternative medicines be handled? (Hjørland and Nissen Pedersen, 592). Though Hjørland and Nissen Pedersen are open to the idea of classification by theory and method applied, and they recognize the advantage of juxtaposing different perspectives, their basic approach ensures that the literatures of these different communities of scholars are classified separately. Only if documents are classified with respect to a universal classification of theory and method can a researcher easily locate works within one or the other tradition. Likewise, given the different terminology used within the two fields, searches by causal link will turn up both perspectives on the link in question only if documents are classified in terms of a universal set of phenomena (and of course if both literatures are classified together). Given the differences in terminology, separate classifications will ensure that practitioners of one type of medicine will have difficulty accessing relevant information from the other, assuming that they are motivated enough to look at the alternative classification in the first place. A unified classification puts alternative perspectives at

their fingertips, but distinguishes these so that the researcher can also choose to ignore them.

Conclusions and Suggestions

Hjørland and Nissen Pedersen are to be applauded for confronting the ambiguity of language, and suggesting one way of coping with this. The purpose of this paper has been to suggest a complementary way forward. Rather than seeking classifications suited only to narrow communities of scholars the goal is a universal classification to facilitate interdisciplinary inquiry. Hjørland and Nissen Pedersen suggest that the best response to the fact that different communities of scholars emphasize different aspects of the same concept is to carefully investigate word use by specific groups of scholars. It has been argued that this ambiguity can be dealt with by defining concepts narrowly *and* by classifying all possible links among concepts. It has been argued further that concepts should be defined in terms of phenomena, theory, or method. Phenomena should be defined functionally when a clear reference to their internal essence is unavailable. Such a strategy seems capable of responding to various concerns raised by Hjørland and Nissen Pedersen. I have taken the first steps toward such classifications elsewhere (Szostak 2003a, Szostak 2004), but will end here with the simple conclusion that the increased importance of interdisciplinarity in the academy means that information scientists must continue to strive toward universal classifications. The value of such an enterprise is obvious, and should not be negated by an exaggerated sense of the difficulties involved.

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Notes:

¹ Sundin and Johannisson (2005) urge information scientists to debate epistemological issues. As Hjørland (2005) notes in his introduction to that issue of this Journal, information scientists have only rarely paid attention to philosophy of science. The articles he introduces focus on how philosophy can guide research in information science. This article instead emphasizes how classifications themselves can reflect understanding of the nature of the scholarly enterprise.

² Sundin and Johannisson (2005) likewise argue that classifications can only be justified within a particular community. They note that research in information science should be ‘motivated by the pragmatist argument that it has the potential to contribute with tools that will help solve problems within different practices’ (40). What then of interdisciplinary practices?

³ As will be clear below, however, I am skeptical of the claim that the classes in a classification can only be identified ‘pragmatically’ (that is, inductively by looking at how concepts are used). Rather, I argue that a combination of deduction and induction should be employed, and that phenomena can be defined precisely in terms of their essence or function. In this, I follow Gnoli (2004), who in turn builds on the work of Dahlberg. Notably, though, the contours of the disciplines (and many disciplinary concepts) in which current classification systems are grounded can only be identified pragmatically.

⁴ ‘Whereas the student or layman is looking for literature on or about a topic, the scholar/researcher’s information need is, in most cases, substantially different. This group of users deals in ideas and theories, and wants to know whether specific ideas have previously been expressed in the literature. For example, a historian may have a new explanation for the cause of the Civil War, and going to this heading in a subject catalog or periodical index is not likely to answer precisely the question ‘Has anyone ever expressed this theory in print before?’ (Weinberg 1988, 3). Palmer (1996) also advocates classification with respect to method applied.

⁵ In Szostak (2003b) I summarize the analyses of Klein and Salter and Hearn, and develop the following (partial) definition of interdisciplinarity: ‘*Openness* to the application of *all* theories and *all* methods to *any* set of phenomena.’

⁶ The classification of the key phenomena of interest to human scientists was the subject of Szostak (2003c). Perhaps surprisingly, there is a considerable degree of scholarly consensus regarding these. In cases where scholarly consensus does not yet exist, such as in psychological discourse on personality dimensions, it is generally possible to develop a classification which subsumes competing classifications.

⁷ The Italian chapter of the International Society for Knowledge Organization is developing (and testing against the literature) a detailed, universal, and hierarchical classification of phenomena. See www.iskoi.org/ilc/how.htm

⁸ Notably, when López-Huertas investigates the interdisciplinary field of gender studies inductively, she finds that roughly half of the concepts employed are borrowed from other disciplines ‘with the same form and apparently the same sense as they have in their original realm’ (2006, 333). The 32% of terms developed independently within gender studies, and especially the remainder that are developed through interaction with other disciplines, may also share similar meanings in different realms.

⁹ In practice, this could be accomplished by using linked notation between phenomena, as recommended in Szostak (2003c), or by using extra-defined foci as suggested in Gnoli (2006). In the latter case, the notation for certain chemical compounds could follow the notation for medical treatments using pharmaceuticals. See the ISKO Italia website.

¹⁰ Causal relationships were only one type of connection for which Ranganathan recommended linked notation. Another occurred when the subject matter of one discipline was applied to another. Such connections are best captured by classifying works in terms of theory and method applied (below). Ranganathan also discussed possible ways in which concepts might be related definitionally; this concern is also addressed below.

¹¹ Critical realism provides a philosophical justification for the development of a hierarchical classification of phenomena where each phenomenon has a unique place. It also emphasizes links between phenomena, and notes that these can occur between phenomena at different levels in the hierarchy (Wikgren, 2005, Gnoli and Poli, 2004).

¹² Of course some works study a large number of links. The call number should reflect the most important link studied, but all should ideally be classified for the purposes of subject catalogues.

¹³ It *might* be both useful and feasible to designate positive versus negative findings notationally. In practice, scholarly findings fall on a continuum between positive and negative.

¹⁴ Hjørland and Nissen Pedersen emphasize that some theories may treat two concepts as synonyms while others see them differently: while such a problem should ideally disappear with functionally-defined phenomena within a hierarchical structure, if it persists such differences are not problematic as long as searches are possible in terms of both concepts.

¹⁵ Bryant (2000) suggests that a classification in terms of isotope would be as valid as the standard classification in terms of chemical elements. Yet in this case scholarly consensus is grounded in a well developed theoretical understanding of the key differences between different

elements. Moreover, isotopes can readily be classified as subsets of the classification of elements. While different classifications are possible, classification in terms primarily of elements seems to be superior, at least for most purposes.

¹⁶ Despite my general hesitance to define phenomena in terms of theory I would accept the arguments of Gnoli and Poli (2004) regarding the advantages of using evolutionary theory, especially for classifications of biological entities. Of course, biologists still disagree regarding where certain organisms fit in an evolutionary hierarchy. Such disagreements do not limit the value of a classification if consensus is achieved on the boundaries between species. When such consensus is lacking, it can often be handled well by subclasses which may or may not be called separate species.